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EVALUATING THE ROLE OF MUSCLE ENERGY TECHNIQUE FOR GASTRO-SOLEUS TIGHTNESS IN PLANTAR FASCIITIS MANAGEMENT

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ABSTRACT

Introduction: Plantar fasciitis (PF) is a prevalent musculoskeletal disorder primarily presenting with heel pain often associated with tightness in the gastrocnemius-soleus complex. Muscle energy technique (MET), a form of manual therapy, has shown promise in addressing muscular tightness and improving flexibility.

Objective: To evaluate the effectiveness of MET in reducing gastro-soleus tightness, alleviating pain, and improving functional outcomes in individuals with Plantar fasciitis.

Methods: A total of 33 subjects diagnosed with plantar fasciitis were randomly allocate into either, METs group (n = 17) treated with muscle energy technique at the gastro-soleus muscle complex or conventional group (n = 16) received standardized treatment. The baseline pre-test measurement for pain and function were assessed and recorded using numeric pain rating scale (NPRS) and the foot function index (FFI) respectively and the same was recorded as post-test after two weeks of intervention.

Results: The METs group showed a statistically significant reduction in pain and improvement in functional outcomes, with a mean NPRS difference of 4.3 ($p < 0.001$) and an FFI difference of 35.7 ($p < 0.001$). Effect size analysis indicated a larger effect, suggesting strong clinical relevance of the intervention.

Conclusion: The application of Muscle Energy Technique to the gastro-soleus muscle complex resulted in significant pain reduction and improved functional outcomes in individuals with plantar fasciitis. These results support incorporating METs into standard physiotherapy protocols for more effective management of plantar fasciitis.

KEYWORDS

Gastro-soleus, heel pain, muscle energy technique, plantar fasciitis, tightness

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INTRODUCTION

Plantar fasciitis (PF) is the most prevalent source of heel pain, frequently observed among middle-aged and physically active individuals, including athletes[1]. The condition is characterized by localized pain and tenderness over the medial calcaneal tubercle, which is most noticeable during the initial steps in the morning or following extended periods of inactivity. The underlying pathology typically results from repetitive strain and microtrauma to the plantar fascia, leading to inflammation, collagen degeneration, and biomechanical dysfunction. Tightness in the gastrocnemius-soleus muscle complex has been the key contributing factor as it alters foot biomechanics and increased tension on the plantar fascia[2,3]. Additionally, structural abnormalities such as forefoot varus can cause excessive pronation, elevate plantar fascial tension, and stress on the surrounding soft tissues, thereby aggravating the condition[4-6].

Muscle energy techniques (METs), a manual therapy approach, involves the patient's active muscle contraction against a therapist applied resistance to improve joint mobility and reduce muscular tightness[7,8]. It is a non-invasive, patient-centered intervention commonly used for managing musculoskeletal conditions characterized by restricted flexibility and muscle shortening[8,9]. Given the biomechanical relationship between gastro-soleus tightness and increased plantar fascia stree, targeting these muscular limitations through METs may help alleviate pain and enhance functional performance. Although thermal therapy and stretching exercise are widely used, there remains a growing interest in evaluating the specific therapeutic effects of METs in the management of plantar fasciitis.

Thus, this study intends to explore the effect of Muscle Energy Technique in alleviating gastro-soleus muscle tightness, pain and foot function for plantar fasciitis, thereby contributing to evidence-based rehabilitation strategies for addressing one among the biomechanical risk factor in plantar fasciitis.

MATERIALS AND METHOD

This single-center experimental study conducted between October and December 2024 in Out-Patient Physiotherapy Department of Saveetha Medical College and Hospital, was approved by the Institutional Scientific Review Board of the University Saveetha College of Physiotherapy (01/018/2024/ISRB/SR/SCPT) and were in accordance with the ethical standards established in the Declaration of Helsinki of 1946.

Subjects of the age between 25-45 years of both genders, clinically diagnosed with plantar fasciitis with unilateral heel pain lasting for about 4 weeks, baseline pain score of NPRS >5, with positive Windlass test, presence of gastro-soleus tightness confirmed with reduced ankle dorsiflexion were included while history of recent foot/ankle fracture or surgery, Achilles tendon rupture, neurological disorders affecting the lower limb, RA, gout, vascular insufficiency of lower limb and any prior physical therapy or use of corticosteroid injections were excluded from the study.

The sample size was calculated using G*Power 3.1 software. A total of 33 subjects were recruited based on the selection criteria and were allocated randomly (1:1) using computer generated random sequence to either of the groups: muscle energy technique group (METs, n = 17) treated with METs for the gastro-soleus muscle while the conventional group (CG, n = 16) received the usual physiotherapy intervention. Allocation sequences were prepared by an independent researcher not involved in the enrolment. Allocation concealment was ensured using sequentially numbered, opaque, sealed envelopes. Envelopes were opened only after subjects completed the baseline assessment by the clinician. The pre-and post-outcomes for pain using NPRS and function by FFI were assessed following two weeks of intervention period. This study followed a single-blind design, the outcome assessor was blinded to the subjects group allocation to minimize assessment bias. The therapist administrating the intervention was not blinded due to the nature of manual therapy (METs). However, outcome measurement was performed by an independent physiotherapist who was unaware of the group allocation and the study hypotheses.

Study procedure

METs group (n = 17):

1) *Post-isometric relaxation technique for gastrocnemius:* Subject positioned in supine and the therapist at the foot end of the subject. Initially the ankle was passively moved into dorsiflexion until a resistance was felt. Then the subject was instructed to gently plantarflex against the resistance offered by the therapist. Approximately 20% of the effort should be given by the subject. The isometric contraction was held for 5 seconds and then returned to the neutral position. After relaxation, the foot is taken to dorsiflexion passively into new barrier resistance and the resistance is applied. The cycle was repeated thrice per session followed by METs for soleus muscle.
2) *Post-isometric relaxation technique for soleus:* With the subject in supine and knee flexed to 90 degree and the therapist at the foot end. The therapist stabilized the heel and with the knee flexed, the ankle was passively dorsiflexed until a stretch was felt in the soleus muscle. The subject was instructed to gently plantarflex against the resistance (about 20% of their maximum effort) offered by the therapist. The position was held for 5 seconds and then relaxed after which passive dorsiflexion was attempted to the next new barrier. The cycle was repeated thrice per session followed by therapeutic ultrasound therapy.

Conventional group (n = 16)

1) *Standing calf stretch:* The subject stood facing a wall

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with both hands placed at shoulder height. One leg was positioned behind with the knee fully extended and the heel flat on the floor, while the front leg was slightly bent at the knee. The subject was then instructed to lean forward slowly until a stretch was felt in the calf muscle. This position was maintained for 20 seconds before returning to the starting position.

2) *Seated towel stretch:* The subject was positioned in long sitting with a towel looped around the ball of the foot. With the knee in full extension, the subject was instructed to gently pull both the ends of the towel towards themselves until a stretch was felt in the calf and plantar region. The position was held for 20 second before returning to the neutral position.

Both the group were given therapeutic ultrasound followed by exercise.

Therapeutic ultrasound therapy

With the subject in leg crossed sitting or prone lying, Therapeutic Ultrasound of 1 MHz frequency in continuous mode with intensity of 0.8 to 1.2 W/cm^2 for 7 minutes was administered over the plantar fascia near the calcaneus (heel bone) in a linear or circular motion along the length of the plantar fascia[10,11].

Outcome measure

Numeric pain rating scale (NPRS): A 11-point pain scale to rate the intensity of pain, where 0 is "no pain" and 10 as "worst pain imaginable"[11].

Foot function index (FFI): A self-reported questionnaire to assess the impact of foot-related conditions. It evaluates the severity of symptoms and the level of functional impairment by addressing pain, disability, and activity limitations related to foot health[12].

RESULTS

The collected data of the study were analyzed by SPSS version 30. The statistically significant was set at p <0.001.

The study's results detailed in *Tables 1 and 2*, provided insights of the effect of the intervention on pain and foot function in both the groups. The METs group showed very large to extremely larger effect sizes, reinforcing the clinical significance of the technique on gastro-soleus tightness by pain reduction and enhancing the functional outcome in PF, though conventional group demonstrated improvements in the outcomes, but with lesser magnitude.

DISCUSSION

The study examined the efficacy of Muscle Energy technique (MET) applied to the gastro-soleus complex for reducing pain, decreasing gastro-soleus tightness, and improving functional outcomes in subjects with plantar fasciitis. The study findings demonstrated statistically significant improvements in pain and function within the METs group, suggesting that METs may provide a better clinical outcome than conventional treatments.

These outcomes are consistent with previous research stated that both METs and ischemic compression significantly reduced pain and improved function in subjects with plantar fasciitis, though there was no much statistical significance between the two techniques[13].

Similarly recent studies have explored the effectiveness of manual techniques over therapeutic ultrasound in improving pain and ankle flexibility in plantar fasciitis[14].

Literatures have also explored the comparative effects of different active and passive manual techniques on plantar fasciitis, while numerous RCTs undergoing muscle energy technique on patients with plantar fasciitis were compared with interventions such as ischemic compression technique, stretching, trigger release, Cyriax massage and myofascial release techniques reported that METs was more effective in reducing pain, improving joint range and functional mobility in subjects with plantar fasciitis[15].

These findings align with the results of our study, which demonstrated greater functional gains beyond those that might be expected from the standard convention

Outcome	Pre-test (mean ± SD)	Post-test (mean ± SD)	t-value	p value	Cohen's d
NPRS	7.2 ± 0.8	2.9 ± 0.7	15.12	<0.001	5.72 (very large)
FFI	68.4 ± 6.1	32.7 ± 5.5	18.45	<0.001	6.15 (extremely large)

Table 1. *Pre-post mean value of the METs group.*
Abbreviations: NPRS, numeric pain rating scale; FFI, foot function index; SD, standard deviation.

Outcome	Pre-test (mean ± SD)	Post-test (mean ± SD)	t-value	p value	Cohen's d
NPRS	7.0 ± 0.7	5.6 ± 0.8	6.38	<0.001	1.86 (large)
FFI	67.1 ± 5.8	55.9 ± 6.2	5.91	<0.001	1.87 (large)

Table 2. *Pre-post mean value of the conventional group.*
Abbreviations: NPRS, numeric pain rating scale; FFI, foot function index; SD, standard deviation.

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treatment. The therapeutic mechanism of METs techniques involves a combination of neurophysiological, biomechanical and change in the tissue fluid components. Mets primarily involves the application of gentle isometric muscle contraction. The increased generated during this contraction is detected by the Golgi tendon organs, which send inhibitory signals to the posterior horn cells of the spinal cord. This, in turn reduces the excitatory input to the anterior horn cells, leading to a decrease in motor neuron activity causing autogenic inhibition thereby promoting relaxation of the targeted muscles and restoring the optimal resting length of the muscle[16].

The present study demonstrated a considerable reduction in the pain score in the METs group (from 7.2 ± 0.8 to 2.9 ± 0.7; p <0.001), with a very large effect size (Cohen'd = 5.72), similarly, FFI scores significantly improved from 68.4 ± 6.1 to 32.7 ± 5.5; p <0.001), with an extremely larger effect size (Cohen'd = 6.15). These results suggest that MET targeting the gastrocnemius and the soleus muscle was not only statistically but also clinically effective in pain relief and enhancing the foot function in individuals with plantar fasciitis.

The results of the present study align with a study that highlighted the role of post-isometric relaxation METs technique on improving the posterior chain muscle flexibility in the management of plantar fasciitis. The technique specifically targeting the tightness of the gastro-soleus muscle complex- a known biomechanical contributor to increased strain on the plantar fascia- this approach typically addresses the primary underlying source of heel pain, restores myofascial balance and enhances proprioception[17]. This improvements in the foot function index (FFI) reflects enhanced functional recovery, indicating greater tolerance to weight-bearing, walking, and daily activities-key contributing to patient satisfaction and effective long-term management of the condition.

Research emphasizes the importance of a comprehensive and biomechanically focused approach for managing persistent plantar fasciitis, rather than solely addressing symptoms. The findings suggest that conservative treatment methods-such as the use of custom orthotics to correct biomechanical imbalance and provide arch support, physical therapy to restore strength and mobility and stretching exercises to reduce plantar fascia tension-serves as the first line of management.

The study suggests that conservative approaches to pain management and functional enhancement should be the main focus of initial treatment. These include the use of custom orthotics to rectify biomechanical imbalances and offer arch support, physical therapy to restore strength and mobility, and stretching exercises to relieve tension in the plantar fascia. The results of the study also highlighted the necessity of treating chronic plantar fasciitis with a patient-centered, comprehensive strategy[18].

Literatures have supported therapeutic approach in musculoskeletal therapy, low-intensity pulsed ultrasound (LIPUS) has shown great promise in promoting tissue repair, lowering pain, and improving functional recovery[19]. Furthermore, the improved dorsiflexion range and muscle relaxation achieved through METs may contribute to better weight-bearing mechanics and gait efficiency, leading to reduced pain during daily activities. As complementary to conventional therapy, METs is a low-cost, non-invasive and therapist-applied technique that can be seamlessly integrated in to standard physiotherapy practice. Significant changes over a short intervention period suggest METs may expedite recovery, reduce treatment duration and improve compliance.

Despite the promising findings, the study has few limitations to be addressed. First, the sample size was relatively small which may restrict the generalizability of the findings to the lager population of individuals with plantar fasciitis. Secondly, the duration of the intervention and the follow-up was relatively short, limiting the ability to assess long term effects and sustainability of improvements of the outcomes. and the follow-up period was limited with short-term outcomes. Thirdly, since both the groups received ultrasound therapy, the specific independent effect of METs on pain reduction and functional improvement may have been partially masked. Future research would be recommended incorporating these limitations to enhance better understanding of the underlying mechanism and the impact of METs on daily activities and patient well-being.

CONCLUSION

The inclusion of METs in rehabilitation protocol for plantar fasciitis offers a non-invasive, cost effective and functionally beneficial strategy, particularly in case where gastrocnemius- soleus tightness is evident. This ability to provide rapid and substantial improvement in both pain and function supports its use as a first line adjunctive therapy.

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